2814

Patent

#11/13

5/8/02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application: Howell et al.

Serial No.: 09/772,949

Filed: 01/31/2001

Title: COPPER PAD STRUCTURE

Today's Date: April 19, 2002

Group Art Unit: 2814

Examiner: Graybill, David E.

FAX: 703-872-9318

AMENDMENT UNDER 35 U.S.C. 132

To the Assistant Commissioner of Patents
Washington, D.C. 20231

Dear Sir:

In response to the Office Action of December 21, 2001, in which all of pending claims 15-21 stand rejected, kindly amend the subject U.S. patent application as follows. The Patent Office is hereby authorized to charge applicants' Deposit Account 09-0456 such fees as may be due for a one-month extension of time for the filing of this response, as well as for the filing of the newly-submitted claims enclosed herewith. A separate fee sheet is enclosed.

CERTIFICATE OF MAILING

I hereby certify that, on the date shown below, this correspondence is being:

MAIL

☒ deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner of Patents, Washington, DC 20231.

Date: 4/19/02

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Maryann Luisi
Name

Mary Luisi
Signature

In the Claims:

Cancel claim 15.

16. (Amended) The method in claim 20, wherein said same material comprises copper.

17. (Amended)The method in claim 20, wherein said barrier layer comprises one or more layers of Ti, TiN, Ta, and TaN.

18. (Amended) The method in claim 20, wherein said barrier layer prevents elements within said connector from diffusing to said internal components.

19. (Amended) The method in claim 20, further comprising polishing said integrated circuit structure such that said plug, said barrier layer and said exterior form a planar surface.

20. (Amended) A method of forming an integrated circuit structure comprising:

forming a via through an exterior of said integrated circuit structure to internal components of said integrated circuit structure;

lining said via with a barrier layer;

forming a plug above said barrier layer, said plug and said internal components comprising a same material; and

forming a solder ball connector on said plug, wherein said connector is formed to be in direct contact with said plug.

21. (Amended) The method in claim 20, further comprising forming a second barrier layer above said plug and forming a second plug above said second barrier layer, such that said second plug is in direct contact with said connector.

22. The method in claim 20, wherein said solder ball connector is comprised of a lead/tin alloy.

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23. A method of forming a metallurgical structure, comprising:
forming a first layer of copper on a substrate;
forming a barrier layer on said first layer of copper;
forming a second layer of copper formed on said barrier layer; and
forming a conductive structure that includes a given species, at least some of said given species diffusing from said conductive structure, said second layer of copper having a thickness sufficient to at least partially consume said species diffusing from said conductive structure, and to adhere to said conductive structure.

24. The method of claim 23, wherein said conductive structure comprises a solder ball.

25. The method of claim 24, wherein said given species comprises tin.

26. The method of claim 24, wherein said solder ball comprises a lead/tin alloy.

27. The method of claim 24, wherein said barrier layer is selected from the group consisting of Ti, TiN, Ta, Tan, and combinations thereof.

28. The method of claim 24, wherein said second conductive structure has an upper surface that is substantially coplanar with surrounding insulative structures.

Remarks

Applicants respectfully request that this amendment be entered, and that their subject U.S. Patent application be passed to issuance in view thereof. The foregoing amendments are further

indicated in blackline form in Exhibit A, "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

In the Office Action, the Examiner requests that Fig. 1 be corrected to indicate that it depicts the prior art. A proposed drawing correction is enclosed herewith.

In the Office Action, all of pending claims 15-21 stand rejected as being obvious in view of U.S. Patent 6,151,651 (Havemann). Applicants respectfully submit that the Havemann reference neither teaches nor suggests the structure as recited in these claims presented herein. In Havemann, note that whenever a copper metallization is utilized, it is capped with either a conductive barrier layer (note e.g. the front figure of the patent, copper 26 is capped by TiN layer 28) or a nonconductive encapsulant layer (note e.g. copper 52 is capped with a silicon nitride encapsulant 54). In all cases, Havemann teaches utilizing protective layers that prevent impurities from penetrating into the copper. In the invention, the solder ball 25 is disposed directly on the copper layer 25; the purpose of the copper layer immediately below the solder ball is to consume impurities, not to be protected from them (c.f. page 10, lines 2-7 of the present specification). As such, Applicants respectfully submit that Havemann teaches away, rather than toward, the invention, in that it teaches copper applications in which copper is isolated from potential contaminants, not used to help consume them. Applicants have amended their claims by canceling claim 15 and incorporating its limitations into claim 20, as well as specifying that the connecter is a solder ball. Applicants respectfully submit that the rejections of record have been traversed.

Applicants have submitted new claims 22- 28. Applicants respectfully submit that these claims do not recite new matter in that they are supported in the specification and drawing as filed. Applicants further respectfully submit that new claims 22 - 28 recite patentable subject matter. Claim 22 is dependent on claim 20, which was discussed previously. Independent claim 23 specifies that the second layer of copper consumes diffusion species from an overlaying conductor; since the point of the Havemann structure is to protect the copper layers from

impurities, Applicants respectfully submit that claim 23 (along with claims 24-28 dependent thereon) patentably distinguish from the Havemann patent.

Enclosed herewith are copies of references that are not of record in this case that were recently cited in an Office Action on the parent to the present application.

Applicants respectfully request entry of the present Amendment and passage of their subject application to issuance in view thereof. Should the Examiner have any comments, questions, or suggestions, please do not hesitate to contact the undersigned attorney at the telephone number and/or email address set forth below.

Respectfully submitted,
For: Howell et al.

By: _____

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